SHORT REPORT

Title: Loneliness as a risk factor for care home admission in the English Longitudinal Study of Ageing

Background: Loneliness has an adverse effect on health and wellbeing, and is common at older ages. Evidence that it is a risk factor for care home admission is sparse.

Objective: To investigate the association between loneliness and care home admission

Setting: English Longitudinal Study of Ageing (ELSA)

Particpants: 254 Individuals across seven waves (2002-2015) of ELSA who moved into care homes were age, sex matched to four randomly selected individuals who remained in the community.

Methods: Logistic regression models examined associations between loneliness, socio-demographic factors, functional status, and health on moving into care homes.

Results: Loneliness (measured by the University of California, Los Angeles (UCLA) Loneliness Scale and a single-item question from the Center for Epidemiological Studies Depression Scale (CES-D)) was associated with moving into a care home (CES-D OR 2·13, 95%CI 1·43-3·17, p=0·0002, UCLA OR 1·81, 95%CI 1·01-3·27, p=0·05). The association persisted after adjusting for established predictors (age, sex, social isolation, depression, memory problems including diagnosis of Alzheimer's disease, disability, long-term physical health, and wealth). The impact of loneliness (measured by CES-D) on admission accounted for a population attributable fraction of 19·9% (95% CI 7·8%-30·4%).

Conclusions: Loneliness conveys an independent risk of care home admission that, unlike other risk factors, may be amenable to modification. Tackling loneliness amongst older adults may be a way of enhancing wellbeing and delaying or reducing the demand for institutional care.

INTRODUCTION

In England, approximately 400,000 people live in care homes, including one in six of the population aged over 85 years.[1] Many admissions are precipitated by a crisis event, and few people prefer to move into a home if alternatives are available.[2] Finding ways of preventing or delaying admissions to care homes will align with older adults' preferences for care, and may reduce overall welfare costs.[3]

A range of individual characteristics are known to be associated with admission to care homes[4-9] including older age, poor health, functional or cognitive impairment and dementia.[10] Evidence that people who live alone are more likely to move into a care home is inconclusive.[11, 12] Whether persistent feelings of loneliness (i.e. unhappiness with the quality and quantity of their relationships) or social isolation (having few or no contacts or ties with other people)[13] influence decisions to move into care homes, is unclear. Older adults who are lonely or socially isolated have a higher risk of functional decline and cognitive impairment,[14] which may increase the need for residential care. People who report low levels of perceived social support, little engagement in social activities or few social contacts, have been shown to be more likely to move into a care home in studies in the USA and Sweden.[4, 15-17] Russell and colleagues' study of 3097 rural Iowans in the early 1980s, found that older adults with the highest loneliness scores (9-12, on the four item UCLA loneliness scale) were more than six times as likely to be admitted to nursing home over the following four years, when compared to the least lonely.[17] No recent studies have investigated the effect of loneliness on the likelihood of care home admission in a large, nationally representative or unselected European population.

The aim of this study was to investigate the influence of loneliness on admission to care homes, independent of isolation and other potential risk factors.

METHODS

Participants

The English Longitudinal Study of Ageing (ELSA) is a population-based study of adults aged 50 years and above. Participants (15,783 individuals) have been surveyed at two year intervals since 2002. Full details of ELSA methodology are reported elsewhere.[18] In this study we use the term care home to describe (nursing) homes with employed registered nurses,

and (residential) homes without any nursing staff on site. For our analysis, care home residents (cases) were identified by their recorded place of residence, and data extracted from the survey wave before they were first noted to be living in a care home. Participants in wave one, who were recorded as being in care homes or as having moved into care homes after recruitment into the study, but before data collection, were excluded from the analysis. Age (exact year) and sex matched controls from ELSA participants who lived in private households were randomly selected with replacement at each wave in a four to one ratio. All participants were eligible to be a control until the wave prior to the wave when they were recorded as living in a care home.

Variables in our analysis were selected to describe participants' socio-demographic characteristics, physical health, mental health, functioning, isolation and perceptions of loneliness. (Supplementary material Box 1).

Loneliness was measured in two ways. Firstly, the three-item University of California, Los Angeles (UCLA) Loneliness Scale.[19] This asks how often the respondent feels left out; isolated from others; or that they lack companionship. Each question was scored on a three-point scale of 'never or hardly ever', 'some of the time' and 'often'. A score of six or more was classed as lonely. Secondly, a single loneliness item from the Center for Epidemiological Studies Depression Scale (CES-D) was also used.[20] This asks whether respondents felt lonely much of the time during past week. The three-item UCLA scale has been validated and shown to be reliable among older adults, and its correlation with the CES-D single-item measure suggests that both tools measure similar constructs of loneliness.[19]

Social isolation was measured using an approach developed by Steptoe and colleagues.[21] One point was assigned to an individual who is unmarried/not cohabiting; where contact with children, other family members and friends is less than monthly; and where individuals do not participate in organizations such as social clubs or residents groups. Scores range from zero to five, and a score greater than two is used to indicate isolation, in line with previous work. [21]

Statistical analysis

The impact of loneliness on entry into care homes was investigated with two sets of models: one for the CES-D item for loneliness and one for the three-item UCLA Loneliness Scale. Inverse probability weights to account for missingness in loneliness variables were calculated for cases and controls using logistic regression with non-response (to loneliness) as an outcome variable, and age, wave, and ever having had memory problems as predictors. Weighted logistic regression models, adjusting all analyses for sex, age (tertiles), and wave (study design factors) and loneliness were used throughout (Table 1). The impact of other risk factors on the relationship between loneliness and risk of moving into a care home was investigated using additional covariates in the main model. All models were robust to the inclusion of age as either a continuous or categorical (tertiles) variable, we report findings from the categorical age models. An initial analysis was undertaken to ensure that relaxing the conditional assumption of the nested case-control design was valid by using adjustment in the unconditional model (not reported here).

Weighted logistic regression analysis was undertaken using R software version 3.30 (R Core team, Vienna, Austria), multiple imputation and the population attributable fraction were calculated in Stata version 14 (TX: StataCorp LP).

RESULTS

313 (2.0%) of 15,783 ELSA participants resident in the community moved into a care home between waves 2 to 7. Fifty-nine individuals were excluded as they provided no interview data in the wave preceding admission to a care home. Table 1 lists characteristics of the 254 eligible cases and 1016 age, sex, and wave matched controls. The UCLA questionnaire was not administered in wave one.

Table 1 here

Univariate investigation of loneliness with a weighted logistic regression saw increased risk of entry to a care home for both CES-D (OR 2·13, 95%CI 1·43-3·17, p=0·0002) and UCLA loneliness (OR 1·80, 95%CI 1·01-3·27, p=0·05). These models, adjusted for age, sex, and study wave, are the baseline models. The impact of loneliness (as measured by the CES-D

loneliness item) on care home admission in the baseline model accounted for a population attributable fraction (PAF) of 19·9% (95% CI 7·8%-30·4%).

In multivariable analyses using the baseline model plus established predictors and potential confounders, CES-D loneliness remained a risk factor for care home admission when the model included any of the previous predictors (OR ranged between 1·73-2·29, but all remained significant with p values<0·05) (supplementary table 1). The effect was of a similar magnitude even after adjusting for all factors (OR 1·55, 95%CI 0·82 - 2·91) although due to the number of missing observations this effect ceased to be conventionally statistically significant (p=0.17). After adjusting for all factors the CES-D impact on care home admission accounted for a PAF of 13·4% (95% CI -8.1% - 30·6%).

The multivariable models of UCLA loneliness showed a similar consistent elevation throughout adjustments (OR range from 1·46 - 1·81), though due to the smaller number of individuals with a measured value for UCLA loneliness, this variable did not remain conventionally statistically significant (supplementary Table 1).

Social isolation contained a large amount of missing data, (34.5% missing, n=438) which may have impacted on the individuals contributing to the analysis. To ensure the risks of loneliness adjusted for isolation were robust, a sensitivity analysis restricted to individuals with measured isolation was undertaken, the estimates for both CES-D and for UCLA loneliness were similar to the model including all individuals (Table 2).

In a sensitivity analysis to the robustness of the missing data using multiple imputation loneliness was associated with an increased risk of care home admission, whether measured by CES-D (OR 2.12, 95% CI 1.49-3.00) or UCLA (OR 1.73, 95% CI 1.17-2.57) (Table 2).

Table 2 here

DISCUSSION

Our findings suggest that loneliness is associated with an increased risk of moving into a care home, even after adjusting for other well-established factors such as age, depression,

dementia, disability and social isolation. This is important, because unlike many other factors that precipitate admission, loneliness may be amenable to intervention.

Previous work has identified age, poor health, and functional and cognitive impairment as significant predictors of admission to care homes.[10] Our finding – that loneliness is an independent risk factor for admission – is plausible and consistent with with observations in the only previous study of this relationship.[17] Links between loneliness and both mortality and morbidity are well established.[22 23] Recent analysis of data from ELSA has added evidence of an association between high levels of loneliness and progression to physical frailty.[24]

A proportion of ELSA participants were not interviewed in the wave prior to care home admission, perhaps because of physical or mental ill-health. Such attrition is a potential source of bias, but our analysis adjusted for missing data on loneliness and potential risk factors by re-weighting the models to incorporate differential loss. We have also demonstrated that our estimates were robust to missing data in other study variables using multiple imputation. Most epidemiological studies focus on only one measure of social relationships, precluding direct comparison between the objective and subjective appraisal of relationship quantity and quality.[23, 25] The inclusion of measures of social isolation as well as loneliness was a strength of our study, allowing us to establish that feelings of loneliness were associated with care home admission independent of social isolation. We took advantage of the availability of two measures of loneliness in ELSA to check the robustness of our findings to measurement change.

As populations age, the need for care home places is expected to rise and outstrip supply. Addressing loneliness is recognised as an important means of enhancing wellbeing in older age. Our findings suggest that it may also be a way of enabling older adults to remain in their own homes, and reducing the demand for institutional care. Future research could usefully focus on identifying effective interventions to address loneliness amongst older adults, and investigating whether loneliness persists after moving into a care home.

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Conflict of interest

All authors declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Contributors
BH had the idea for the study, and was involved in study design and data interpretation and prepared the first draft of the manuscript. DS and DCM analysed and interpreted the data. NKV was involved in study design, contributed to the interpretation, and drafting of the manuscript. FEM was involved in study design, supervised the data analysis, conducted the multiple imputation, contributed to the interpretation, and drafting the manuscript. All authors revised the manuscript and approved it before submission. DS is the data guarantor.

Table 1: Sociodemographic and health characteristics of cases and controls drawn from ELSA

	All waves			
	Cases		Controls	
Number of participants	254		1016	
Age, years: mean(s.d.)	82·1	7·9	82·1	7·9
Cognitive scores: mean (s.d)	6·6	3·8	11·3	4·0
	n	%	n	%
Cognitive scores missing	98	38·6	131	12·9
Female	174	68·5	696	68·5
CES-D lonely	71	28·0	213	21·0
CES-D lonely missing	72	28·3	46	4·5
UCLA lonely[1]	30	11·8	156	15·4
UCLA lonely missing[1]	172	67·7	414	40·7
Poor self-rated health	108	42·5	309	30·4
Lowest wealth tertile	102	40·2	314	30·9
Moderate disability	142	55·9	335	33·0
Mild disability	41	16·1	81	8·0
Unmarried	171	67·3	635	62·5
Living alone	144	56·7	544	53·5
No living children	41	16·1	154	15·2
No living siblings	118	46·5	424	41·7
Isolated	38	15·0	188	18·5
Isolated missing	162	63·8	276	27·2
Depressed	74	29.1	223	21.9
Depressed missing	74	29.1	49	5.8
Psychiatric problems	30	11.8	54	5.3
Diagnoses and health conditions				
Dementia	74	29.1	31	3·1
Heart disease	97	38·2	301	29·6
Stroke	59	23·2	94	9·3
Diabetes	42	16·5	97	9·5
High blood pressure	141	55·5	529	52·1
Arthritis	123	48·4	486	47·8
Cancer	22	8·7	101	9·9
Lung disease	12	4·7	73	7·2

[1] UCLA loneliness scale was not administered at wave 1 of ELSA

Table 2: Association between loneliness and risk of entering a care home amongst ELSA participants

	Model	n	Odds ratio*	[95% CI]	p
CES-D					
	Baseline	1152	2·13	[1·43 - 3·17]	<0·001
	Baseline[a]	819	2·51	[1·38 - 4·54]	0·003
	Baseline + isolation	819	2·36	[1·30 - 4·27]	0·005
	MI (baseline + isolation) [b]	1270	2.12	[1.49 - 3.00]	<0.001
UCLA					
	Baseline	683	1·81	[1·01 - 3·27]	0·049
	Baseline[a]	618	1·81	[0·95 - 3·47]	0·073
	Baseline + isolation	618	1·78	[0·94 - 3·37]	0·077
	MI (baseline + isolation)[b]	1270	1.73	[1.17 - 2.57]	0.006

*Adjusted for age (in tertiles), study wave and gender. CI confidence interval

[a]Baseline model for individuals not missing isolation data

[b] Multiple imputation: Loneliness estimate adjusted for social isolation, age, study wave and gender (imputation model includes both outcomes, age, study wave, gender plus all other factors in Supplementary Table 1 in imputation model)

Supplementary methods

Multiple Imputation

A sensitivity analysis to the missing data was investigated using multiple imputation by chained equations. Factors included in the imputation model were the loneliness outcomes CES-D, UCLA, age (as tertiles and continuous), sex, and all factors in Supplementary table 1. Logistic imputation models were used for CES-D, UCLA, depression, self-rated health, with ordered logistic imputation model for cognitive impairment/dementia, wealth and disability - 100 imputation datasets were created. Logistic regression for CES-D and UCLA were undertaken separately with estimates combined using Rubin's Rules. Standard Stata MI commands were used.

Supplementary Box 1: A description of the ELSA variables used in the study

Variable	Description
Depression	Depressive symptoms as measured by seven items from the CES-D (the loneliness item was omitted from the overall score to avoid overlap with the loneliness measure). A score of 3 or more symptoms was classified as depressed.
Psychiatric problems	A binary variable that indicates whether the respondent reported ever having any emotional, nervous, or psychiatric problems.
Cognitive scores	The combination of scores from the orientation and word recall tasks (the only cognitive tasks applied at all waves). Orientation (ability to name the current date, month, year and day of the week) scores range from 0-4 (higher is better), total word recall is the sum of scores for immediate (range 0-10) and delayed recall (range 0-10). Maximum possible score is 24 (higher

	is better). The score was inverted in the analysis (1-total score) and tertiles were calculated (lowest tertile is worst performing).
Self-rated health	Self-rated health at waves one, two, four, five, and six was recoded to two levels (excellent, very good and good recoded to 'good' and fair/poor recoded to 'poor'). At wave three, ELSA used the European self-rated health scale, which was recoded to 'good' for very good and good, and 'poor' for fair, bad and very bad
Long-term physical health conditions	Presence of a long-term physical health condition was marked by response to ever having had any of the following diagnoses: arthritis, heart disease, lung disease, arthritis, stroke, cancer, diabetes, or high blood pressure. Number of items reported was used as a continuous variable in the analysis.
Dementia	Whether the respondent reported having Alzheimer's disease or dementia, organic brain syndrome, senility or any other serious memory impairment. Where individuals did not respond to questions about diagnosed memory impairment, presence of dementia was identified using informant responses to the IQCODE as in previous research[26]
Wealth	Per-wave-tertiles for total net non-pension household wealth, which is the sum of savings, investments, and physical wealth after financial debt is subtracted.
Disability	Individuals with no ADL/IADL difficulties were coded as no disability, individuals with

	one or more IADL difficulties but no ADL difficulties were coded as mild disability, and individuals with one or more ADL difficulty were coded as having moderate disability.

Supplementary Table 1: Risk for entering a care home for measures of loneliness and isolation in ELSA participants

		Confounder effect			Loneliness estimate		
	Confounder	Odds ratio*	[95% CI]	p value	Odds ratio*	[95% CI]	p value
CES-D (n)							
1152	No confounder	-	-	-	2·13	[1·43 - 3·17]	0·0002
1147	Depression	1.65	[1.07 - 2.53]	0.0234	1.73	[1.07 - 2.53]	0.0159
1152	Dementia	15·67	[6·75 - 36·39]	<0·0001	2·29	[1·60 - 3·29]	<0·0001
1152	Psychiatric problems	1.52	[0.83 – 2.78]	0.18	2.08	[1.40 – 3.08]	0.0003
1029	Highest cognitive tertile	1.00	(ref)	-	-	-	-
	Middle cognitive tertile	4.75	[2.43 - 9.26]	<0·0001	-	-	-
	Lowest cognitive tertile	19.94	[10.16 – 39.14]	<0·0001	1.91	[1.28 – 2.85]	0.0016
1152	Moderate disability	2·34	[1·54 - 3·55]	<0·0001	2·12	[1·41 - 3·20]	0·0003
	Mild disability	5·77	[3·08 - 10·81]	<0·0001	-	-	-
	No disability	1.00	(ref)	-	-	-	-
1152	n health conditions	1.23	[1.07-1.40]	0.0033	1.96	[1.31 - 2.94]	0.0011
1151	Self-rated health	2·20	[1·52 - 3·20]	<0·0001	1·77	[1·20 - 2·62]	0·0042
1137	Highest wealth tertile	1.00	(ref)	-	-	-	-
	Middle wealth tertile	1·53	[0·91 - 2·56]	0·1087	-	-	-
	Lowest wealth tertile	1·63	[0·93 - 2·89]	0·0893	1·97	[1·30 - 2·99]	0·0014
1126	All factors above**	-	-	-	1.42	[0.90 – 2.24]	0.12
819	Isolation	1·61	[0·88 - 2·93]	0·1193	2·36	[1·30 - 4·27]	0·0047
799	All factors in table**	-	-	-	1.55	[0.82 – 2.91]	0.17
UCLA (n)							
684	No confounder	-	-	-	1·81	[1·01 - 3·27]	0·0485
672	Depression	1.56	[0.80 - 3.07]	0.1944	1.51	[0.75 - 3.02]	0.2490
684	Dementia	18·51	[6·63 - 51·65]	<0·0001	1·56	[0·93 - 2·62]	0·0892
684	Psychiatric problems	1.09	[0.35 – 3.40]	0.88	1.80	[0.99 – 3.28]	0.0556
603	Highest cognitive tertile	1.00	(ref)	-	-	-	-
	Middle cognitive tertile	3.39	[1.46 – 7.91]	0.0048	-	-	-
	Lowest cognitive tertile	19.71	[8.21 – 47.32]	<0·0001	1.72	[1.00 – 2.97]	0.049
684	Moderate disability	1·80	[0·94 - 3·45]	0·0753	1·65	[0·89 - 3·08]	0·1125
	Mild disability	3·99	[1·45 - 10·99]	0·0075	-	-	-
	No disability	1.00	(ref)	-	-	-	-
684	n health conditions	1.17	[0.93 - 1.48]	0.1822	1.69	[0.94 - 3.06]	0.0808
684	Self-rated health	2·20	[1·32 - 3·67]	0·0027	1·46	[0·82 - 2·57]	0·1926
672	Highest wealth tertile	1.00	(ref)	-	-	-	-
	Middle wealth tertile	1·05	[0·51 - 2·13]	0·8998	-	-	-
	Lowest wealth tertile	1·09	[0·51 - 2·33]	0·8226	1·80	[0·99 - 3·28]	0·0535
660	All factors above**	-	-	-	1.15	[0.62 – 2.17]	0.64
619	Isolation	1.15	1.78	0.6912	1.78	[0.94 – 3.37]	0.0768
596	All factors in table**	-	-	-	1.38	[0.69 – 2.75]	0.37

*Adjusted for age (in tertiles), wave, gender, and confounder. CI confidence interval

**Due to collinearity between dementia and cognitive scores, 3 composite groups were created. Dementia/lowest cognitive tertile in the lowest group, and middle/highest cognitive tertiles in the remaining two groups

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